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ORIGINAL ARTICLE

Clinical Analysis of Hypertension in Children Admitted to the Emergency Department

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Background: Hypertension in children is a relatively rare disease and has a high risk of further severe damage. The current study aimed to survey the clinical spectrum of hypertension in children admitted to an emergency department (ED).
Methods: We reviewed the medical records of all children aged 18 years and younger in whom a diagnosis of hypertension was made at the ED in Changhua Christian Hospital between 1998 and 2008. The patients were divided into four age groups (infants, preschool-age, school-age and adolescents) and three severity levels (transient hypertension, hypertension and hypertensive crisis). Case distribution analysis of hypertension based on different months and years was performed. Body mass index, blood pressure, etiologies and presenting symptoms were also analyzed according to age groups and severity levels.
Results: A total of 99 children met the inclusion criteria and were included in the current study. Diagnoses included 15 transient hypertension (15.1%), 28 hypertension (28.3%) and 56 hypertensive crises (56.6%). Almost all of the hypertensive crisis patients presented with stage 2 hypertension (n=55, 98.2%). Dizziness and headache were the most common presenting symptom in patients in school-age and adolescent groups. Of the symptoms described, altered mental status and coma were most common in preschool-age and school-age groups. Neurologic disorder (26.3%) was the most common etiology in children younger than 6 years of age, followed by renal disorders (21.0%). In children older than 6 years of age, the major etiologies of hypertension and hypertensive crisis included untreated primary hypertension, renal disorders and endocrine disorders.
Conclusion: Hypertension in children may be easily underestimated but is potentially life-threatening in the pediatric ED. Primary care clinicians should promptly identify patients with stage 2 hypertension and treat them immediately and appropriately to prevent damage to cardiovascular organs.

1. Introduction

Hypertensive disease has been the most common cause of death in Taiwan since 2001, and the prevalence of hypertension was reported to be approximately 0.5% among children 6–18 years old and approximately 3% among children 7–12 years old.[1,2] The incidence of hypertension among children is increasing with the increasing prevalence of obesity, salt intake and hyperlipidemia.[3–5] Childhood

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hypertension has been demonstrated to be a risk factor for the early development of cardiovascular structural and functional changes.[3,4] Furthermore, children with severe hypertension have increased risk of end-organ damage and hypertensive encephalopathy.

The causes of hypertension vary with different age groups. Most hypertensive children over the age of 6 years suffer from primary hypertension; in those with hypertension over the age of 15 years, 90% suffer from primary hypertension.[6,7] Secondary hypertension is more prevalent in children than in adults, with the major causes being renal and/or endocrine diseases. In the pediatric emergency department (ED), it is frequently a challenge to accurately measure the blood pressure of an irritable and crying child, to appropriately diagnose hypertension in patients with nonspecific symptoms, and to immediately prescribe appropriate treatments for hypertensive children. However, very few studies to date have clinically analyzed hypertension in children admitted to the pediatric ED. Thus, the aim of the current study was to analyze the clinical spectrum of hypertension in children, including the case distribution, the degrees of severity and the possible etiologies and clinical manifestations of hypertension in children of different age groups admitted to an ED.

2. Materials and Methods

2.1. Patient population

We conducted a retrospective chart review of all patients aged 18 years and younger in whom a diagnosis of hypertension was made at the pediatric ED at Changhua Christian Hospital between January 1998 and January 2008. Patients younger than 18 years old who presented with hypertension as the primary diagnosis in pediatric ED were included. The exclusion criteria were inadequate data for body height or weight and no repeated measurement of blood pressure(BP). After excluding 22 cases, a final sample of 99 children were included.

The patients were divided into four age groups: infant (<1 year old), preschool-age (≥1–6 years old), school-age (>6–12 years old) and adolescent (>12–18 years old). Patients were subcategorized into three severity levels: transient hypertension, hypertension without symptoms, and hypertensive crisis. The severity category was based on the primary diagnosis rather than on past history of hypertension.

2.2. Blood pressure (BP) measurement

All children above 3 years old received BP measurement in our pediatric ED. For those who were bedridden and infants who could not sit, BP was checked while they were in a seated position with their back supported, feet placed on the floor, right arm supported, and with the cubital fossa at the level of the heart. An appropriate cuff size was used with an inflatable bladder width that was at least 40% of the arm circumference at a point midway between the olecranon and the acromion. The cuff bladder length covered 80–100% of the circumference of the arm. Initially, aneroid manometers (automatic devices) were used to measure BP with an appropriate cuff. If the systolic BP (SBP) or diastolic BP (DBP) was high, it was re-measured at other limbs. Ambulatory blood pressure monitoring was used to measure BP every hour in patients who presented with unstable BP and in patients requiring further observation.

2.3. Classification of hypertension

Hypertension in children more than 12 months old was defined according to BP standards based on sex, age and height, as stipulated in the updated classification of hypertension by the National Blood Pressure Education Program Working Group on Hypertension in Children and Adolescents.[3,5] Hypertension was identified as SBP or DBP greater than or equal to the 95th percentile; stage 1 hypertension was an SBP or DBP within the range of the 95th percentile to the 99th percentile plus 5 mmHg; stage 2 hypertension was SBP or DBP greater than the 99th percentile plus 5 mmHg. For patients younger than 12 months old, hypertension was defined as SBP or DBP greater than the 95th percentile for infants of similar age, size and sex according to a previously published report.[8] When the percentiles for SBP and DBP differed, patients were categorized according to the higher value. Transient hypertension was considered as a transient BP elevation caused by any emotional, painful or uncomfortable events[9] and defined as asymptomatic BP higher than the 95th percentile only once or twice, but returned to less than the 95th percentile on the second or third measurement without use of antihypertensive medication.

Hypertensive crisis was further classified as hypertensive emergency, hypertensive urgency or hypertensive encephalopathy. Hypertensive emergency was defined as hypertension in combination with acute or ongoing target-organ lesions, or hypertension associated with an immediate life-threatening event requiring immediate intervention to reduce BP. Hypertensive urgency was defined as an elevation in DBP higher than 120 mmHg with no evidence of target-organ lesion.[9–11] Hypertensive encephalopathy was defined as severe hypertension in conjunction with symptoms such as headache,

altered mental status, seizure or visual disturbances, and the presence of reversible posterior abnormalities on T2-weighted brain magnetic resonance images.[12]

2.4. Analytical methods

The following variables were collected and analyzed: age, sex, weight, height, body mass index (BMI), family history, BP upon arrival at the ED, clinical manifestations of hypertensive crisis (dizziness, headache, nausea/vomiting, visual symptoms, seizure type, change in consciousness, chest tightness/pain and target-organ damage), reversibility, antihypertensive drugs, underlying causes [renal disease, cardiovascular disease, primary hypertension, central nervous system (CNS) disorders, endocrine disorders, metabolic disorders and oncological diseases], recurrent episodes and duration of hospitalization in the ward/intensive care unit. In addition, the distribution of cases with transient hypertension, hypertension without symptoms and hypertensive crisis were surveyed according to year and month of presentation. BP, etiology and clinical manifestations were also analyzed according to age group and level of severity.

2.5. Statistical analysis

Statistical analyses were performed using Fisher's exact test, Kruskal-Wallis test, Jonckheere Terpstra test and χ^2 test for trends. A p value <0.05 was considered statistically significant.

3. Results

3.1. Demographics

Between January 1998 and January 2008, 121 patients presented at our pediatric ED with primary diagnosis of hypertension. Eighteen patients were excluded because their BP was less than the 95th percentile, and four more were excluded due to inadequate data. The final sample comprised 99 patients with hypertension. The male to female ratio was 3.7 to 1 (boys, $n=78$; girls, $n=21$). There was a significant difference in the ratio between boys and girls in all age groups, except for the preschool-age group. There were 7 patients (7.1%) in the infant group, 12 patients (12.1%) in the preschool-age group, 36 patients (36.4%) in the school-age group, and 44 patients (44.4%) in the adolescent group. The characteristics of the patients are listed in Table 1. The number of patients with transient hypertension, hypertension or hypertensive crisis in each age-group is also shown in Table 1.

Our study revealed that BMI and SBP increased significantly with age, particularly after the first year of age. SBP was greater than the 99th percentile plus 5 mmHg in 89 patients (89.9%), but only 62 patients (62.6%) had DBP greater than the 99th percentile plus 5 mmHg. Almost all hypertensive patients in pediatric ED presented with SBP higher than the 99th percentile plus 5 mmHg, except for the 8 of the 12 patients (66.7%) in preschool-age group (Table 1). SBP, DBP and BMI for patients in the different severity levels are presented in Table 2. The mean SBP/DBP in hypertensive crisis patients was 160/102 mmHg, and almost all of the patients presented with SBP or DBP greater than the 99th percentile plus 5 mmHg (55/56, 98.2%). The mean BMI was higher among patients with non-symptomatic hypertension, although BMI did not differ significantly between age-groups ($p=0.542$).

The yearly and monthly distributions of transient hypertension, asymptomatic hypertension and hypertensive crisis are presented in Figures 1A and 1B. The incidence of hypertension increased progressively from 2000 to 2008 (Figure 1A). The incidence of asymptomatic hypertension significantly decreased during July and August, while increased during November and December. The incidence of hypertensive crisis and transient hypertension was not significantly correlated with season.

3.2. Etiologies

CNS disorders and neurologic disorders (encephalopathy with epilepsy) were the major etiologies of hypertension in the infant group. Untreated primary hypertension was the most common cause of hypertension (64.3%) and hypertensive crisis (45.5%) in children over 6 years old, and the number of patients increased significantly with age ($p=0.03$). Renal disease was the most common etiology of secondary hypertension (22.2%) in patients aged >6–18 years, followed by endocrine disorders (26.3%). Endocrine disorders were more likely to induce hypertensive crisis (18%) than hypertension without symptoms (3%).

3.3. Clinical findings

Among the clinical manifestations of hypertensive crisis in children, dizziness was the most common symptom ($n=32$, 32.3%), followed by headache ($n=30$, 30.3%), chest pain/tightness ($n=22$, 22.2%) and nausea/vomiting ($n=21$, 21.2%; Table 1). Nausea/vomiting were the most common presenting symptoms in patients in the preschool-age group. Dizziness and headache were the most common presenting symptoms in patients in the school-age group and the adolescent groups. Of the symptoms

Table 1 Age distribution of clinical manifestations and underlying causes of patients with hypertension

Age groups (yr)	Infant <1 (n=7)	Preschool-age ≥1–6 (n=12)	School-age >6–12 (n=36)	Adolescent >12–18 (n=44)	Total (N=99)	p*	$p^{\dagger}$
Female	0	5 (41.7%)	9 (25.0%)	7 (15.9%)	21 (21.2%)	0.130	
Male	7 (100.0%)	7 (58.3%)	27 (75.0%)	37 (84.1%)	78 (78.8%)		
Family history	0	1 (8.3%)	10 (27.8%)	11 (25.0%)	22 (22.2%)	0.297	
Pre-HTN	0	1 (8.3%)	0	0	1 (1.0%)	0.128	
Stage 1 HTN	0	3 (25.0%)	3 (8.3%)	4 (9.1%)	10 (10.1%)		
Stage 2 HTN	7 (100.0%)	8 (66.7%)	33 (91.7%)	40 (90.9%)	88 (88.9%)		
SBP>99th percentile +5 mmHg‡	7 (100.0%)	8 (66.7%)	34 (94.4%)	40 (90.9%)	89 (89.9%)	0.073	
DBP>99th percentile +5 mmHg‡	6 (85.7%)	7 (58.3%)	24 (66.7%)	25 (56.8%)	62 (62.6%)	0.496	
Change in consciousness§							
No change§	5 (71.4%)	10 (83.3%)	34 (94.4%)	42 (95.5%)	91 (91.9%)	0.011	
Disturbance§	2 (28.6%)	0	0	2 (4.5%)	4 (4.0%)		
Drowsy§	0	1 (8.3%)	0	0	1 (1.0%)		
Coma§	0	1 (8.3%)	2 (5.6%)	0	3 (3.0%)		
Headache	1 (14.3%)	2 (16.7%)	13 (36.1%)	14 (31.8%)	30 (30.3%)	0.539	
Nausea/vomiting	2 (28.6%)	3 (25.0%)	8 (22.2%)	8 (18.2%)	21 (21.2%)	0.832	
Visual symptoms	0	0	0	2 (4.5%)	2 (2.0%)	0.673	
Seizure type	1 (14.3%)	2 (16.7%)	1 (2.8%)	2 (4.5%)	6 (6.1%)	0.171	
Dizziness	2 (28.6%)	1 (8.3%)	15 (41.7%)	14 (31.8%)	32 (32.3%)	0.200	
Chest tightness/pain	0	2 (16.7%)	11 (30.6%)	9 (20.5%)	22 (22.2%)	0.361	
End-organ damage§	2 (28.6%)	0	1 (2.8%)	1 (2.3%)	4 (4.0%)	0.039	0.036
Underlying causes	4 (57.1%)	6 (50.0%)	16 (44.4%)	17 (38.6%)	43 (43.4%)	0.802	
Renal disease	3 (42.9%)	1 (8.3%)	9 (25.0%)	10 (22.7%)	23 (23.5%)	0.445	
Essential HTN§	0	3 (25.0%)	17 (47.2%)	25 (56.8%)	45 (45.9%)	0.018	0.003
CNS§	2 (28.6%)	3 (25.0%)	2 (5.6%)	3 (6.8%)	10 (10.2%)	0.054	0.028
Endocrine	1 (14.3%)	0	5 (13.9%)	7 (15.9%)	13 (13.3%)	0.650	
CVD§	1 (14.3%)	2 (16.7%)	1 (2.8%)	1 (2.3%)	5 (5.1%)	0.082	0.044
Oncology	0	1 (8.3%)	1 (2.8%)	0	2 (2.0%)	0.233	
Recurrent episode	4 (57.1%)	3 (25.0%)	11 (30.6%)	17 (38.6%)	35 (35.4%)	0.453	
Severity levels							
Transient HTN	0	3 (25.0%)	6 (16.7%)	6 (13.6%)	15 (15.2%)	0.701	
Asymptomatic HTN	1 (14.3%)	4 (33.3%)	9 (25.0%)	14 (31.8%)	28 (28.3%)		
Hypertensive crisis	6 (85.7%)	5 (41.7%)	21 (58.3%)	24 (54.5%)	56 (56.6%)		
Ward	3 (42.9%)	4 (33.3%)	8 (22.2%)	9 (20.5%)	24 (24.2%)	0.491	
ICU	0	2 (16.7%)	2 (5.6%)	3 (6.8%)	7 (7.1%)	0.477	
POU	0	0	1 (2.8%)	1 (2.3%)	2 (2.0%)	1.000	

*Fisher's exact test; $^{\dagger}\chi^2$ test for trend; $^{\ddagger}p<0.1$; $^{\S}p<0.05$. HTN = hypertension; SBP = systolic blood pressure; DBP = diastolic blood pressure; CNS = central nervous system; CVD = cardiovascular disease; ICU = intensive care unit; POU = pediatric observation unit.

Table 2 Correlation between the severity of hypertension and patient characteristics, blood pressure and length of hospitalization

	Transient HTN Mean±SD (*n*)	Asymptomatic HTN Mean±SD (*n*)	Hypertensive crisis Mean±SD (*n*)	*p**
Age (yr)	10.87±4.50 (15)	11.41±4.61 (28)	10.49±4.74 (56)	0.442
BMI (kg/m^2)	23.08±9.72 (8)	29.08±14.26 (20)	24.33±11.22 (46)	0.542
SBP†	138.73±15.77 (15)	148.39±13.60 (28)	160.73±26.21 (56)	0.000
DBP†	89.27±12.24 (15)	90.75±16.37 (28)	102.45±22.86 (56)	0.001
Ward (d)			5.92±3.86 (24)	
ICU (d)			6.43±4.72 (7)	
POU (d)			0.10±0.09 (2)	

*Jonckheere Terpstra test; †$p<0.05$. HTN = hypertension; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; ICU = intensive care unit; POU = pediatric observation unit.

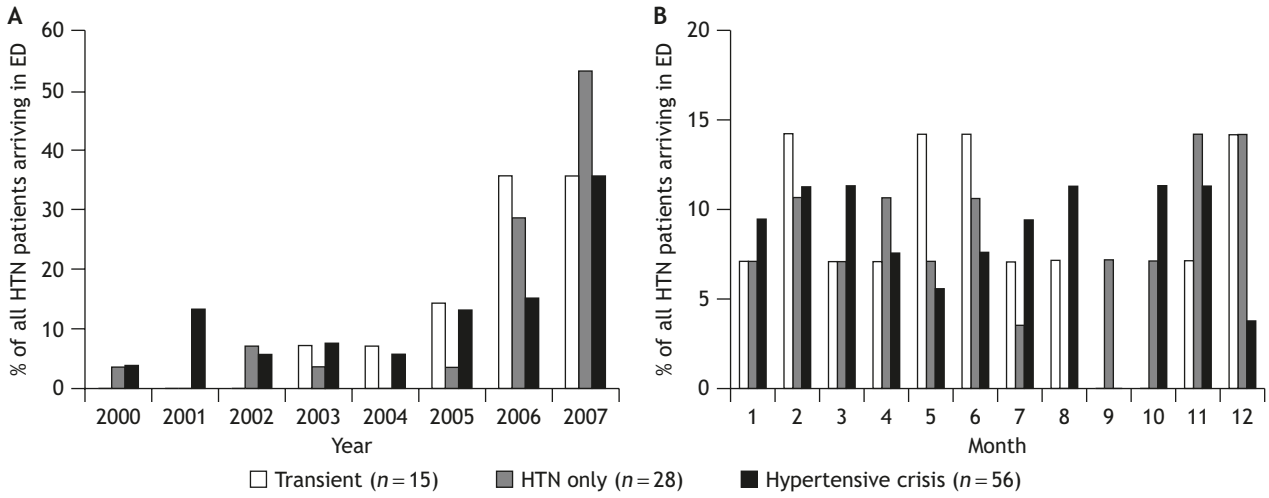

Figure 1 Distribution of hypertension in children between 2000 and 2007 according to (A) year and (B) month. HTN = hypertension; ED = emergency department.

recorded, altered mental status and coma were significantly correlated with the preschool-age and school-age groups. Six patients suffered from hypertensive emergency, which was significantly correlated with age, and the number of cases decreased with age ($p=0.036$). Four patients among them suffered from hypertension encephalopathy. Magnetic resonance imaging of the brain revealed increased signal intensity in the subcortical white matter and cortical gray matter of the parieto-occipital area, cerebellum and basal ganglia. Magnetic resonance spectrometry showed a high lactate peak with normal N-acetyl aspartate, choline and creatine levels.

Transient hypertension was diagnosed in 15 patients (15.1%), asymptomatic hypertension was diagnosed in 28 patients (28.2%), and hypertensive crisis was diagnosed in 56 patients (56.6%; Table 2). Thirty-five patients (35.3%) were brought to the pediatric ED for recurrent hypertension. Correlations between the severity of hypertension and other factors are presented in Table 3. There was a significant correlation between hypertensive crisis and stage 2 hypertension.

3.4. Hospital course

A total of 44 patients (44.4%) with hypertension received antihypertensive agents; 10 of these received multiple antihypertensive agents. Long-acting amlodipine besylate was used for 10 patients in the ED; atenolol for nine patients; captopril for six patients; nifedipine for five patients; carvedilol, inderol and labetalol were used separately for 3 cases; and pentoxifylline, servidipine, lisinopril and nicametate for one case each. However, only half of the patients with hypertensive crisis received antihypertensive agents while in the pediatric ED, indicating that delayed treatment was still high in the pediatric ED (Table 3). The recurrence rate of hypertension was 35.4% (35 cases) during the study period and was significantly higher in patients with asymptomatic hypertension ($n=17$, 60.7%; Table 3).

Table 3 Correlation between the severity of hypertension and other factors

	Transient HTN ($n=15$)	Asymptomatic HTN ($n=28$)	Hypertensive crisis ($n=56$)	p^*	$p^\dagger$
<1 year old	0	1 (3.6%)	6 (10.7%)	0.701	
≥1–6 years old	3 (20.0%)	4 (14.3%)	5 (8.9%)		
>6–12 years old	6 (40.0%)	9 (32.1%)	21 (37.5%)		
>12–18 years old	6 (40.0%)	14 (50.0%)	24 (42.9%)		
Family history‡	2 (13.3%)	11 (39.3%)	9 (16.1%)	0.047	
Female	6 (40.0%)	6 (21.4%)	9 (16.1%)	0.139	
Male	9 (60.0%)	22 (78.6%)	47 (83.9%)		
Pre-HTN‡	1 (1.8%)	0	0	0.002	0.008
Stage1 HTN‡	4 (31.5%)	4 (14.3%)	1 (1.8%)		
Stage2 HTN‡	10 (66.7%)	24 (85.7%)	55 (98.2%)		
SBP >99th percentile+5 mmHg‡	10 (66.7%)	24 (85.7%)	55 (98.2%)	0.001	0
DBP >99th percentile+5 mmHg‡	6 (40.0%)	13 (46.4%)	43 (76.8%)	0.003	0.002
Change in consciousness					
No change	15 (100.0%)	27 (96.4%)	49 (87.5%)	0.919	
Disturbance	0	1 (3.6%)	3 (5.4%)		
Drowsy	0	0	1 (1.8%)		
Coma	0	0	3 (5.4%)		
Headache‡	1 (6.7%)	1 (3.6%)	28 (50.0%)	0	0
Nausea/vomiting‡	2 (13.3%)	1 (3.6%)	18 (32.1%)	0.004	0.016
Visual symptoms	0	0	2 (3.6%)	0.677	
Seizure	0	1 (3.6%)	5 (8.9%)	0.598	
Dizziness‡	2 (13.3%)	4 (14.3%)	26 (46.4%)	0.003	0.002
Chest tightness/pain	1 (6.7%)	5 (17.9%)	16 (28.6%)	0.171	
End-organ damage	0	0	6 (10.7%)	0.357	
Underlying causes	5 (33.3%)	10 (35.7%)	27 (49.1%)	0.42	
Renal disease	2 (13.3%)	7 (25.0%)	14 (25.5%)	0.715	
Primary HTN‡	2 (13.3%)	18 (64.3%)	25 (45.5%)	0.005	
CNS	2 (13.3%)	2 (7.1%)	6 (10.9%)	0.813	
Endocrine§	1 (6.7%)	1 (3.6%)	11 (20.0%)	0.1	
CVD	0	3 (10.7%)	2 (3.6%)	0.352	
Oncology	0	0	2 (3.6%)	0.676	
Recurrent episode‡	1 (6.7%)	17 (60.7%)	17 (30.4%)	0.001	
Ward	0	0	24 (42.9%)	0	0
ICU	0	0	7 (12.5%)	0.069	0.03
POU	0	0	2 (3.6%)	0.677	0.26

*Fisher's exact test; †χ^2 test for trend; ‡$p<0.05$; §$p<0.1$. HTN = hypertension; SBP = systolic blood pressure; DBP = diastolic blood pressure; CNS = central nervous system; CVD = cardiovascular disease; ICU = intensive care unit; POU = pediatric observation unit.

4. Discussion

In our pediatric ED, it is recommended that BP be measured in all children over 3 years old, although BP measurement is usually difficult in uncooperative patients. Some studies have revealed wide variations in BP in children presenting at different institutions.[13] In addition, the symptoms for hypertensive crisis in children are usually nonspecific. These two factors may be responsible for the underestimation of hypertension and hypertensive crisis in children in pediatric EDs. Stewart et al[14] conducted a study in 2005 and concluded that BP measurement is not worthwhile in children presenting at an ED with non-urgent problems and obvious underlying causes. However, in our study, the younger hypertensive children seemed to have suffered from more severe symptoms such as end-organ damage and altered mental status, and only half of the patients with hypertensive crisis had underlying causes and

only 16% of these had a family history of hypertension. Thus, our results suggest that it is very important to measure BP in younger children with acute, nonspecific problems.

Although not all of the patients who present with stage 2 hypertension experienced a hypertensive crisis, a patient who presents with severe hypertension, particularly young children with stage 2 hypertension, should be treated carefully if the event is associated with any symptoms. In our study, among patients with stage 2 hypertension, 12 presented with DBP greater than 120 mmHg, and three (25%) of these patients developed hypertensive encephalopathy. We believe that a blurred area exists in diagnosing pediatric hypertensive crisis, and suggest that primary clinicians should pay more attention to patients presenting with stage 2 hypertension, and prescribe antihypertensive medication early. During our study period, the distribution of children with hypertension showed a predominant increase after 2006, which may indicate the increasing awareness of the importance and existence of childhood hypertension in pediatric EDs.

Previous studies have revealed that there are no significant sex differences in the incidence of hypertension in the first 5 years of life.[3,8] However, our data revealed that in children aged less than 1 or over 6 years old, there was still a male predominance. In terms of BMI, a previous study showed that hypertension was significantly related to BMI in men.[2] Our data revealed a non-significant association between the severity of hypertension and BMI. Although patients with asymptomatic hypertension had a high mean BMI ($29.08 \pm 11.22\,kg/m^2$) and a high percentile of primary hypertension ($n=18$, 64.3%), only a few cases were reported to develop hypertensive crisis.[15] However, only half of the patients with hypertensive crisis had obvious underlying causes. Therefore, we should pay close attention to any hypertensive children, regardless of the etiology, except for some patients with primary hypertension.

Although a few cases of hypertensive encephalopathy associated with mildly elevated BP have been reported,[12] primary care clinicians in the ED should pay close attention to children with severe hypertension, regardless of the etiology. According to the National Blood Pressure Education Program Working Group on Hypertension in Children and Adolescents,[3,5] one of the criteria for hypertensive crisis is the presence of any symptom in association with DBP above 120 mmHg. However, a DBP level of 120 mmHg seems too high for approaching hypertension in children, for almost every patient. All of the patients with hypertensive crisis in our study nearly met the criteria for stage 2 hypertension. Accordingly, we suggest the upper BP limit should be set at the 99th percentile level plus 5 mmHg. Furthermore, patients with hypertensive crisis in our study had higher SBP or DBP levels than patients with asymptomatic hypertension, but only SBP showed a significant increase with increasing age. These findings indicate that younger children with mildly elevated SBP may suffer from hypertension crisis. Thus, their DBP should also be measured to determine whether its level is high or not.

The age of onset of hypertension was correlated with the etiology of hypertension. CNS or neurologic disorders, followed by renal disorders were the leading causes in children at or younger than 6 years of age; untreated primary hypertension followed by renal disorders, were the leading causes in children greater than 6 years old. Additionally, the incidence of hypertension caused by cardiovascular disease seemed to decrease with age. Therefore, clinicians should try to identify the underlying causes to manage hypertension in children, particularly in children at or younger than 6 years of age. A few underlying causes could lead to higher BP levels and increased risk of end-organ damage. Endocrine disorders, for instance is believed to induce acute severe BP in some cases, although renal diseases and essential hypertension also play major roles in patients with hypertensive crisis. Abdominal pain was the most common clinically-presented symptom associated with transient hypertension in all age groups in our study, in contrast with results from a previous study,[11] where renal factors, drug/poison intake, and central and autonomic factors were reported to be the most common factors.

In our study, untreated primary hypertension was the main etiology of hypertension (65.3%) and hypertensive crisis (45.5%); primary hypertension rarely resulted in hypertensive emergency, and no cases contributed to hypertensive encephalopathy. This implies that primary hypertension may be a relatively benign cause of hypertension. We also found that for children of preschool age, nausea/vomiting followed by headache, were the most common symptoms, while dizziness and headache comprised the majority of clinical symptoms in children greater than 6 years of age. In addition, changes in consciousness and end-organ damage were more prevalent in infants and preschool-aged children than in older children. If clinicians do not identify these symptoms or signs promptly, hypertension may progress to severe disease in the absence of appropriate and immediate treatment.

In conclusion, pediatric hypertension may be an underestimated condition, but it remains a potentially critical syndrome within the setting of the pediatric ED. Primary clinicians should pay

close attention to patients with stage 2 hypertension, and must treat it immediately and appropriately once a diagnosis is made. On the other hand, even if the patient had no obvious underlying cause or past history of hypertension, if the patient has elevated BP and acute onset of nausea/vomiting, dizziness or headache, BP should be measured and appropriate treatments should follow immediately to prevent the condition from deteriorating and causing damage to the cardiovascular structures.

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